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Authors: Agnieszka M. Kolodziejczyk, Marta Targosz-Korecka, Marek Szymonski

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Nanomechanical testing of drug activities at the cellular level: case study for endothelium-targeted drugs

Agnieszka M. Kolodziejczyk[1,2], Marta Targosz-Korecka[1] and Marek Szymonski[1]

[1]Research Centre for Nanometer-Scale Science and Advanced Materials, NANOSAM, Faculty of Physics, Astronomy, and Applied Computer Science, Jagiellonian University, Prof. Stanislawa Lojasiewicza Street no. 11, 30-348 Krakow, Poland
[2]Bionanopark Ltd., 114/116 Dubois Street, 93-465 Lodz, Poland

Corresponding author: Agnieszka M. Kolodziejczyk, Bionanopark Ltd., 114/116 Dubois Street, 93-465 Lodz, Poland, e-mail: aga.szczygiel@gmail.com

Abstract

Background: The pharmacological treatment of cardiovascular diseases that may potentially be attributed to endothelial dysfunction often requires the application of endothelium-targeted drugs. Simvastatin is one such drug currently on the market due to its established anti-inflammatory activities. The nanomechanical response to drug treatment at the cellular level is not yet known. However, this response mechanism is promising as a prospective testing method for newly developing drugs.

Methods: Force spectroscopy was used for *in vitro* characterization of the elastic properties of human microvascular endothelial cells. Cell dysfunction was caused by the application of tumor necrosis factor alpha. The anti-inflammatory action of the compounds was investigated for the cells incubated with each of the following agents: simvastatin, pyridine derivatives (1,4-dimethylpyridine chloride (1,4-DMP), and 1-methylpyridinium chloride (1-MP)). Moreover, in the case of 1,4-DMP and 1-MP, the measurements were supplemented with F-actin labeling data.

Results: We measured the simvastatin influence on the elasticity of human microvascular endothelial cells (HMECs) for concentrations: 1, 10 and 100 μM. Furthermore, we evaluated the therapeutic and preventive effects of 1 μM drug on inflamed cells. Finally, the effect of